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a quarterly newsletter from the GES DISC

Fall 2000 ⁂ Volume 2 ⁂ Number 2

Data Mining at the GES DAAC

KDD Services at the Goddard Earth Sciences Distributed Active Archive Center

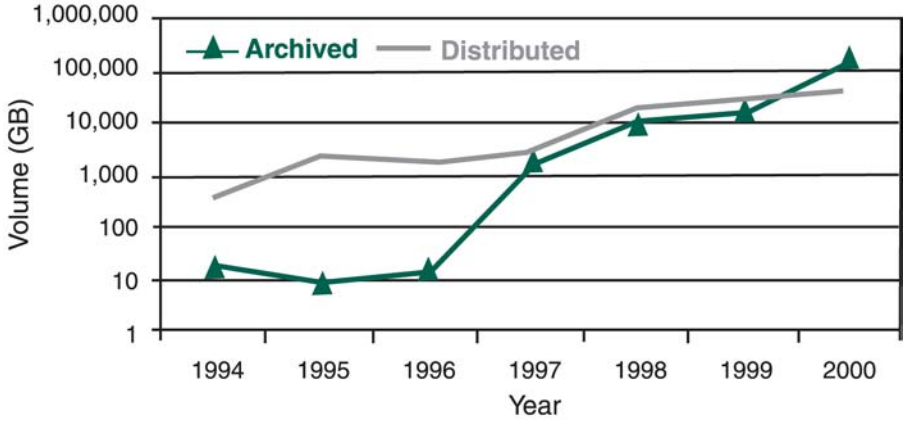
by Christopher Lynnes and Robert Mack

Submitted as a proposed chapter for the book *Data Mining for Scientific and Engineering Applications*

review by Lee Kyle

The high volume of information generated by modern satellite instruments presents researchers with vital new information, but it also presents them and the archive centers with new data handling problems and expenses. Many researchers are interested in only a fraction of the data they receive and run data mining or knowledge discovery algorithms on the data from the archive in order to extract items of interest. When data storage is a problem the remainder is often discarded. In their article, Lynnes and Mack treat the development of techniques to do this type of knowledge discovery directly at the Goddard Earth Sciences (GES) Distributed Active Archive Center (DAAC). Thus the researchers can receive only the subsets of data that they are interested in. It is similar to taking home from the library copies of a few encyclopedia articles rather than the entire set of encyclopedia volumes. This type of procedure is called "knowledge discovery from data bases" (KDD). The more recent satellite data sets with large scale, often global coverage, and resolutions from a few kilometers down to a fraction of a kilometer can put a heavy data processing burden not only on the researchers, but also on the data archives that ship the data to them. For instance, the GES DAAC Version 2 operating system that handles the MODIS satellite instrument data at present supports ingest of 400 gigabytes per day and distribution of 400 gigabytes per day, a 1:1 ratio. The data flow rates are being increased, but always at a 1:1 ratio. The GES DAAC is developing KDD capabilities as one way to continue to serve the needs of its customers. A recent KDD test sponsored by the Tropical Rain Measuring Mission (TRMM) Science Team reduced the volume of shipped data by a factor of 4 in one case and a factor of 37 in another.

A few years ago the GES DAAC took pride in distributing up to 100 times the volume of data that were taken in. However in recent years advances in satellite instrument technologies and in our ability to process data have risen faster than our ability to store and distribute the data. Thus at present we are actually ingesting data into the archive faster than we can distribute it.



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Data Mining at the GES DAAC, continued from page 1

Volume Distributed and Archived Each Year at the GES DAAC

Here I should point out that at present only about 20% of our ingested data are imported from outside. The rest consists of products produced by science algorithms running at the GES DAAC or on nearby science team machines with local broadband connections to the GES DAAC. This discrepancy between input and output is likely to grow over time. At present tapes are used as our major archive and distribution media, and both the relatively slow improvement rate in tape technology and in the tape handling costs will work to keep the data shipment volumes below the ingest volume. The GES DAAC network distribution capacity is increasing, but it still lags behind our present tape handling capacity. Furthermore, network distribution requires that the users have sufficient bandwidth and disk space to accommodate the data. Experience has shown that as bandwidth increases so does the general traffic; thus, as bandwidth increases we can expect network congestion to continue to be a problem.

Many researchers would like to search our archived data for specific phenomena and have little use for the majority of the data. To aid them the GES DAAC is establishing an architecture to support KDD by its users. A prototype system has been developed and tested with cooperation and funding support from the TRMM program. To a limited extent our users can already do spatial and temporal subsetting of certain of our data sets remotely using search and order programs available through our Web pages. However, researchers will often want to supply their own KDD algorithms but this can only be done with the active cooperation of DAAC analysts. Often runtime parameters and other algorithm adjustments need to be made that require knowledge of the DAAC operating system. A more subtle challenge for data centers is the management of resources such as CPU requirements, disk space, and archive throughput. The data center must be able to execute individual KDD algorithms without significantly degrading the distribution performance for the community at large. This last constraint virtually rules out KDD "on demand" at this time.

KDD Campaigns

The GES DAAC's solution is to run KDD "campaigns," analogous to reprocessing campaigns in which the data center feeds large amounts of data to support science processing. Interested users supply algorithms and GES DAAC analysts work with them to integrate the algorithms into our KDD system. This is an external subsystem that interfaces with the GES DAAC system in a manner similar to that of other data producers. This KDD system orders data from the archive, processes it through the KDD algorithms, then sends the output products back to the archive to be distributed to the user through the standard system. In the archive the KDD products are kept segregated from the public data and are retained for a limited period (months to 1 year) in case the user asks for it to be resent.

At present our KDD system can accept user supplied algorithms in C, Fortran, and IDL. Algorithms written in IDL can take advantage of built-in functions for handling the Hierarchical Data Format (HDF) in which most of the GES DAAC's data are stored. The submitted algorithms must follow certain conventions to allow them to be run remotely with no operator intervention. This will allow them to run in a background mode that can adjust to the other work loads on the archive system. Other than these our KDD system places few restraints on the submitted algorithms. In collaboration with the user, the submitted algorithms are tested and benchmarked to determine what computer resources they require. Then they are integrated into the KDD system at the archive and tested again to be sure that the user is satisfied with the results.

The initial campaign was done on TRMM data with a variety of algorithms from several investigators, executing operations ranging from straightforward subsetting to an algorithm that detects fires from radiance values. The reduction factors range from a factor of 3 to about 40.

ALGORITHM	INPUT DATA	OUTPUT	VOLUME REDUCTION
Fire detection	Visible-Infrared Radiance	Fire locations	14:1
Coincident subsetting	Precipitation radar rainfall	Satellite rainfall subsets coincident with rain gage locations	37:1
Content-based subsetting	Microwave, precipitation radar, and multi-instrument rainfall products	Subsets selected based on histograms and precipitation rates	4:1, an average; cases ran from 2.5:1 to 6:1

Algorithms, TRMM input data, and output data for first KDD campaign

Future Directions

Steve Kempler, Head of the Goddard Earth Sciences Data and Information Services Center (GES DISC), which includes the GES DAAC, says that our present KDD system is a prototype we expect to improve and expand. In the near future our KDD system should expand to accommodate MODIS data.

A major resource problem found in this initial KDD campaign was the need to draw data out of the archive in competition with the normal archive activities. This could be avoided by running KDD on ingest (i.e., extraction of metadata). In this case the KDD algorithms would be executed just after ingest. This could be done either with incoming satellite data or with reprocessed data at the archive step. This would require the KDD algorithms to be ready at the time of the creation of the data products.

The present KDD procedures require a hands-on collaboration between users and GES DAAC analysts to integrate the user supplied KDD algorithms into the GES DAAC KDD system. In the future the GES DAAC may set up a KDD testbed or sandbox with a sample KDD system and data sets where the user could do the integration and testing before the algorithms are transferred to the archive's operational KDD system.

We Want To Hear From You

The GES DISC welcomes inquiries from users with interest in possible KDD efforts in connection with our archived data sets; however, at present our prototype KDD system handles only TRMM products. Inquiries concerning TRMM should be submitted to Robert Mack,

mack@eosdata.gsfc.nasa.gov

Inquiries about future KDD efforts for MODIS Level 1 and Ocean and Atmospheric science products should be sent to Bruce Vollmer,

vollmer@daac.gsfc.nasa.gov

Focused Views of NASA's Global Change Master Directory

by Lola Olsen & Gene Major

Content Now Available for Special Interest Groups

NASA's Global Change Master Directory (GCMD) is a unique resource offering a data set discovery service to nearly 9,000 Earth science data set descriptions. As one of NASA's contributions to the Committee on Earth Observation Satellites (CEOS), the GCMD has flourished through its international collaborations. Both the evolving software development and the Earth science content have been nourished by the CEOS partners, leading to a vibrant and expanding International Directory Network (IDN) for locating climate change, atmospheric science, hydrology, oceanography, geology, geography, or human dimensions of global change data. Assisting anyone interested in locating Earth science and global change data sets and linking directly to them remains the foundation of this effort.

Earth science data are described in the GCMD using the Directory Interchange Format (DIF) metadata format. Metadata have been described as "data that characterizes source data, describes their relationships, and supports the discovery and effective use of data" (Burnett, et al., 1999).

Metadata as a data management tool serves two functions. One is to provide administrative, content, archival, and data management support. The second is to assist users in determining where data exist, who has them, how to acquire them, their quality, and how to transfer or link to them.

In ongoing efforts to maintain the quality of the directory, numerous multipurpose metadata authoring and modification tools are offered to those contributing to directory content. Recognizing the criticality of maintaining the currency of Web links within the directory, more than 17,000 links are currently checked on a rotating basis using software designed for this purpose and corrected when necessary.

In collaboration with IDN partners, NASA has been experimenting with providing the capability for topically oriented science groups to serve subsets of data set descriptions through a directory "portal." IDN partners or other interested focused groups can customize an interface—specifically targeting the nature of their selected subset of the total content. The resulting portal can be designed to suit the needs of the group by creating a virtual "view" of that selected portion of the directory. Using the quality-controlled science keywords, a targeted science keyword search option can be presented to the users to glean the scope of a particular directory view. Free-text searching is another option for the portal's clients.

The portal concept was originally conceived to offer a collection of data sets for NASA's Earth Science Information Partners (ESIP) Federation. Through this portal

http://gcmd.nasa.gov/cgi-bin/md/esip_search.pl

one can query only those data sets that are part of the Federation. All of the DAACs are considered Type 1 ESIPs—responsible for standard data and infor-

Focused Views of NASA's GCMD
continued from page 3

mation, where Type 2 ESIPs represent data and information products and services that are developmental or research in nature, and Type 3 ESIPs represent data and information products and services to users beyond the Earth System Science research community.

A prototype portal was also created for the Antarctic Master Directory to search and retrieve Antarctic data set descriptions

http://gcmd.nasa.gov/amd/amd_params.html

for which the sample collection used was based on data sets identified by the participants of the Joint Committee on Antarctic Data Management. Another prototype example highlights the data sets from the Global Observing Systems Information Center

http://gcmd.nasa.gov/gosic/ft_search.html

collected by three major observing programs: Global Climate Observing System, Global Ocean Observing System, and Global Terrestrial Observing System. Other portals have been designed that offer data sets specifically targeting their named hosts, such as the Global Observations of Forest Cover (a CEOS program) and the U.S. Department of Agriculture's Agriculture Research Data Directory. Future portal development is anticipated for the Global Disaster Information Network, the Global Ecosystem Dynamics program of IGBP, and the International Oceanographic Data Exchange.

References

Burnett, K., K. B. Ng, and S. Park, 1999. A comparison of the two traditions of metadata development. *Journal of the American Society for Information Science,* 50:13:1209-1217.

ESIP Federation Home Page
http://www.esipfed.org/

GCMD Home Page
http://gcmd.gsfc.nasa.gov/

Joint Committee on Antarctic Data Management Home Page
http://www.jcadm.scar.org/

GES DAAC News

New Data Products
General News
People in the News

— as reported by George Serafino and the Customer Support Teams —

NEW DATA PRODUCTS AND SERVICES

ATMOSPHERIC CHEMISTRY

Ozone and other trace gas compositions, dynamics, and energy interactions of the upper atmosphere.

MLS Data From UARS

The Microwave Limb Sounder (MLS) data from the UARS satellite (1991–1998) are in the process of being replaced with version 5 data. The version 5 MLS data include two new geophysical parameters: methyl cyanide (CH_3CN) and geopotential height. Data will be made available incrementally as they are delivered to us. The replacement should be completed early in 2001. To order these data go to

http://daac.gsfc.nasa.gov/data/dataset/UARS/01_Instruments/MLS

UARS WINDII Data

The UARS WIND Imaging Interferometer (WINDII) Version 9 winds will soon be replaced with Version 11 winds (1991–1998). These are measurements of the velocity of upper atmospheric wind fields above 80 kilometers. To order WINDII data go to

http://daac.gsfc.nasa.gov/data/dataset/UARS/01_Instruments/WINDII

ATMOSPHERIC DYNAMICS

3-D dynamic and thermodynamic state of the Earth-atmosphere system, from satellite measurements and assimilation systems.

New Software and Online Features

Try our prototype version of the Online Analysis Software (OASIS) system for use with atmospheric dynamics data sets. It provides basic data manipulation, visualization, and analysis capabilities to the user prior to ordering. Also try our new Web based "Parameter Search" feature for Atmospheric Dynamics data (e.g., TOVS Pathfinder and Data Assimilation) to facilitate discovery, search, and order of data based on geophysical measurements.

HYDROLOGY

Global precipitation, its variability, and associated latent heating, important for studying the global hydrological cycle, climate modeling, and applications.

TRMM Data Products

A new data set, "Janowiak Global 4 km IR Data Set," has recently been made operationally accessible from the TRMM Web interface.

http://lake.nascom.nasa.gov/data/dataset/TRMM/01_Data_Products/index.html

This data set consists of global (60N to 60S) gridded IR brightness temperatures at 4 km spatial resolution and half-hourly time steps, merged from multiple geostationary satellites (GOES, Meteosat, and GMS). It is produced for the Global Precipitation Climatology Project (GPCP). Also note that the TRMM Web interface has been slightly rearranged, as follows:

- the new Janowiak data set can be found under the "Ancillary" Data Product Group
- the two products that formally were under the Ancillary Group (GPCC and GPI) are now under the "ftp Download" Data Product Group.

GDAAC Web GIS

The GDAAC WebGIS (Geographical Information System) is currently operational at

http://daac.gsfc.nasa.gov/WEBGIS/

and user feedback is continually being sought for future enhancements. Increasing available data formats, as well as online tools for display and analysis, will enable a greater number of GIS users to incorporate GDAAC data in their work.

LAND BIOSPHERE

Long time-series vegetation and thermal infrared brightness temperature data sets for global change research.

NDVI Data on CD

A new set of AVHRR Pathfinder Land (PAL) 10-day continental normalized difference vegetation index (NDVI) is available on CD ROM. It includes the latest solar zenith angle corrections for a 19 year period beginning July 1981 (land biosphere).

MODIS DATA SUPPORT

Radiance data and auxiliary information such as geolocation and cloud mask, atmospheric profiles, and higher level ocean color data.

Beta Data Products

The MODIS science team is releasing preliminary (beta version) science products for evaluation. By common convention instantaneous science products along the satellite orbit path are labeled L2, while mapped (gridded) time and space quantities produced from L2 products are labeled L3. The beta products that have been released are

Atmospheric Products

L2 products: aerosol properties, cloud properties, total precipitable water, cloud mask, plus temperature and water vapor profiles

L3 products: daily, 1° global joint product. This includes averages and statistics produced from the L2 products.

Ocean Products

L2 products include SST, group 1 parameters (e.g., case 1 water chlorophyll), group 2 parameters (e.g., case 2 water chlorophyll), and water-leaving radiances

L3 products include

- 6 binned daily and weekly products (4.63 km resolution)
- 32 mapped daily and weekly products (4.63 km and 36 km resolution)
- 16 mapped daily and weekly 1° products

Online Data Ordering

The GDAAC Search & Order mechanism (Terra-WHOM) is now implemented for MODIS Atmospheric and Ocean products. It allows simple point and click searching for all products. Level 2 also features spatial and temporal queries. You don't need a tutorial to understand it! Try it out.

http://acdisx.gsfc.nasa.gov/data/

OCEAN COLOR

Remote sensing ocean color data used to investigate ocean productivity, marine optical properties, and the interaction of winds and currents with ocean biology.

New SeaWiFS Evaluation Product

SeaWiFS Photosynthetically Active Radiation (PAR) released to the public includes 8-day and monthly PAR for 09/97–10/00. More products are to follow at a later date. SeaWiFS PAR is a vital quantity for estimating primary production rates in the ocean.

A Real Hit

Very popular with the educational community, the SeaWiFS Poster Teaching Supplement (PDF and hardcopy versions available) was the subject of a NASA Press Release on 10/11/2000. Two hundred Supplements and SeaWiFS Posters were distributed on the first day (November 16) of the Regional National Science Teachers Association meeting in Baltimore and many more were requested on subsequent days.

Coming Soon

An External Browser (CD-ROM) containing SeaWiFS images and ordering mechanism has been developed and initially evaluated by SeaWiFS Project staff. Modified External Browser, including all files from the second half of 2000, will be sent to several beta testers approximately mid-January. The file ordering procedure has been simplified and made more user friendly. The External Browser will allow users to order data files based on browse imagery independent of the DAAC Web browsing system, which can have a very slow response time for overseas users.

Also be sure to check out our other important data products in the areas of

FIELD EXPERIMENTS

Aircraft and ground based measurements of meteorological variables designed to improve science algorithms and validate satellite-derived data products,

INTERDISCIPLINARY

Global land, ocean, and atmospheric parameters mapped to uniform spatial and temporal scales for basic research and applications studies.

For more details about the GES DAAC data holdings and to order data see our Home Page or contact us by eMail, phone, or fax.

http://daac.gsfc.nasa.gov/

eMail: daacuso@daac.gsfc.nasa.gov
voice: 301-614-5224
fax: 301-614-5268

GENERAL NEWS

The new Aqua launch date is Thursday, July 12, 2001, with a scheduled launch from Vandenberg Air Force Base at 1:30 a.m. There should be some impressive data from the Aqua instruments within the succeeding months.

DISC News—New DISC Support Contractor

Science Systems and Applications, Inc. (SSAI) won the new GES DAAC support contract and took over December 1, 2000, from Raytheon ITSS. Many, but not all, of our contract employees are covered by this contract. As is usual in such cases, most of our old Raytheon ITSS staff members, including the local manager Lindsley (Lee) Bodden, transferred to the new contractor. SSAI is a well-known contractor around Goddard and the change should be entirely transparent to our customers.

Meetings and Publications

Steve Kempler hosted the EOSDIS DAAC Managers Quarterly Meeting here in Building 32, October 24–26. The main subjects for discussion were security compliance with NASA 2810, event and problem reporting, data billing and accounting to recover distribution costs, user services, Federation, New DISS, and ECS operations issues. In addition, Dr. Mike Thomas, Director of Code YO, presented and discussed his views of the Earth Sciences Enterprise Outreach Program.

James Acker presented the paper "Satellite and airborne remote sensing observations of neritic carbonate transport from the Bahamas Banks and Bermuda" at the Carbonate Beaches 2000 conference, December 5–8, 2000, in Key Largo, FL, sponsored by the United States Geological Survey and Coastal Zone Foundation. (A similarly entitled paper has been submitted to the International Journal of Remote Sensing.) Contacts made at the meeting may lead to the organization of a session or sessions on remote sensing of coastal sediments at a conference to be held in spring 2003.

A new Science Focus! Web article on the Southern Ocean Iron Enrichment Experiment (SOIREE) was published.

http://daac.gsfc.nasa.gov/CAMPAIGN_DOCS/OCDST/soiree.html

The phytoplankton bloom created by the addition of iron to Southern Ocean waters south of Australia was observed by SeaWiFS over a period of 55 days. Images of the bloom were featured on the cover of *Nature,* the British weekly science journal, accompanying research articles concerning the SOIREE campaign.

Sunmi Cho presented a poster paper "Data From the GEOS-Terra Data Assimilation System at the GES DAAC" at the American Geophysical Union's 2000 Fall meeting, December 15–19, in San Francisco. Coauthors were Jianchun Qin and Mahabaleshwara Hegde.

ABSTRACT

Near real-time global, gridded atmospheric assimilation time series data from the Goddard Earth Observing System (GEOS)–AM1 Data Assimilation System (DAS) will be available for public distribution in 2001. The Data Assimilation Office (DAO) at Goddard Space Flight Center (GSFC) produced this data set as a direct support to the operation of the EOS Terra satellite (formerly known as EOS–AM1) which was launched on December 18, 1999.

The new features of the GEOS-DAS comprise three parts: high spatial resolution, improved physical parameterizations of the general circulation model (GCM), and an enhanced analysis algorithm by including an advanced Physical Space Statistical Analysis System (PSAS). The improvement in the physical parameterizations includes a Mosaic land surface model and a moisture turbulence scheme in the planetary boundary layer. In the analysis algorithm, PSAS replaces the GEOS-1 optimal interpolation (OI). The new GEOS moisture analysis uses rawinsonde moisture measurements to estimate model bias and corrects the model forecast accordingly. This results in unbiased moisture analyses with respect to rawinsonde observations. GEOS-DAS also incorporates total precipitation water (TPW) into the assimilation.

The resulting full time series provides 136 physical quantities including wind, temperature, humidity, cloud parameters, total ozone, and other important surface parameters. The data are global in HDF-EOS format and have spatial resolution of 1° latitude by 1° longitude except ozone, which have a resolution of 2° latitude by 2.5° longitude. In calculating variables for this data set, the DAO makes a distinction between synoptic fields, snapshots taken at a given synoptic time and time averaged products, averages either centered on the output time, or upstream averages. Single level or 2-dimensional data are produced every 3 hours while 3-dimensional data are output every 6 hours.

In the near future the data described above together with documentation, application, online images, and read programs will be freely available through the World Wide Web (WWW) at

http://daac.gsfc.nasa.gov/CAMPAIGN_DOCS/atmospheric_dynamics/

Greg Leptoukh presented a paper entitled "Ocean Data From MODIS at the NASA Goddard DAAC" at the Ocean Optics XV Conference October 15–21, 2000, in Monaco.

James Koziana presented a seminar entitled "MODIS Data Support and Services at the Goddard Earth Science DAAC" on November 27, 2000, as part of the Commonwealth Center for Coastal Physical Oceanography Seminar Series. The center is part of Old Dominion University in Norfolk, Virginia.

Five members of the MODIS Data Support Team attended the Fall AGU Meeting in San Francisco (December 14–19). They had a booth with new backdrop posters and new handouts. They also presented five poster papers.

- MODIS Ocean Products at the NASA Goddard Earth Sciences (GES) DAAC
- MODIS Atmospheric Products at the Goddard Earth Sciences (GES) DAAC
- MODIS Aerosols, Water Vapor, and Cloud Products for Earth Radiation Budget Studies
- MODIS Level-1 Browse Imagery at the GES DAAC
- MODIS Data Support and Services at the Goddard Earth Science DAAC

The five team members were **Jim Koziana, A. K. Sharma, Suraiya Ahmad, Bryan Zhou,** and **Dimitar Ouzounov.**

Nathan Pollack presented the paper "WebGIS for Enhanced Access and Use of GDAAC Data" at the WebGIS 2000 Conference in November at Penn State University in State College, PA. His coauthors were William Teng and George Serafino.

ABSTRACT

Satellite remote sensing data produced and archived at the NASA Goddard Space Flight Center Distributed Active Archive Center (GDAAC) are currently not widely used by the Geographical Information System (GIS) community. A WebGIS would enhance the access and use of GDAAC data, allowing GIS users to preview data and, optionally combined with GIS data layers, to provide online analysis capability. Existing WebGIS software packages could not be used, because they are not designed to handle the primary data formats (HDF or binary), volume (Terabytes monthly), or large number of files (hundreds of thousands available) dealt with at the GDAAC.

To address these unique problems a custom WebGIS has been developed as part of a larger effort to increase the information density of GDAAC data delivered to the user. In the current version, the user selects criteria (region and date of satellite image) and is then offered a choice of ancillary GIS data layers (political boundaries, cities, roads, rivers, etc.). The software searches the GDAAC data holdings and reads and displays the retrieved data and associated GIS data layers to create a map. The result is then displayed in a Web browser with the user being able to download the map and the satellite data available in traditional GDAAC formats (HDF or binary) or GIS formats (shape files, OpenGIS standards). Check it out at

http://daac.gsfc.nasa.gov/WEBGIS/

George Serafino and his team gave a demonstration of a proof-of-concept version of the Environment and Health (E&H) Research and Information System to Dr. Nancy Maynard. This system makes use of OpenGIS standards to allow health researchers and other applications users easy access to Earth science data of potential use in understanding the influence of environmental variables on a wide range of health problems. The objectives of this demonstration include

- establish proof of concept for various data flows in prototype, including search, access, insertion, receipt of images and data, and using sample satellite and point data sets, relevant to environment and health research
- provide scheme for health and environment information dissemination to prospective users
- obtain feedback in terms of both short- and long-term directions for the system as driven by E&H user requirements.

The presentation demonstrated the following capabilities.

- E&H information portal
- retrieval of both global and local

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coverage satellite data sets via Digital Earth (DE) client
- retrieval of point (station) data sets via DE client
- overlaying and spatial subsetting (zooming) of sample DE data sets
- insertion, retrieval, and downloading of E&H data via RODIN User Submission (RUS) mechanism, a product of Code 930.

PEOPLE IN THE NEWS

Gary Alcott Heads Ops

Welcome Gary T. Alcott as the new GES DAAC Operations Manager. Operations is the group that keeps the Earth science data smoothly flowing into our archive from the primary sources and then out again to our many customers. It also runs the large-scale science product number crunching that produces many of our useful data products. He is an experienced manager whose most recent previous position was Missions Systems Operations Director for EDOS. He writes,

"I graduated from Penn State with a BS in Computer Science in 1984. I started at GSFC in May 1985 and worked in operations on level 0 processing systems in the old Code 560, Information Processing Division (IPD). In 1989, I left Goddard and worked for DOD in acceptance testing of avionics systems at the Naval Air Development Center in Warminster, PA. I returned to GSFC and IPD in 1991. I worked as both operations engineer and operations manager on both Pacor II and EDOS. After several years I moved on to EDOS supporting Code 423, ESDIS, full time. This year marked 15 years of civil service and 8 years on EDOS, taking it from cradle to adulthood. I'm looking forward to exploring new territory as part of the GDAAC."

Congratulations Scott Barnes!

In October, Scott was appointed the new Operations Lead for the V0/V1 Operations Group, replacing Liz Kennedy who did an outstanding job in this position. Liz has moved to Savannah, GA. We expect Scott to do just as good a job.

The Global Scanner is a publication of NASA's Goddard Space Flight Center Earth Sciences (GES) Data & Information Services Center (DISC).
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